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Liu QING et al.

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For: ENHANCED LOCAL AAA REDIRECTOR

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Commissioner for Patents
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Sir:

The benefit of the filing date of the following prior foreign application filed in the following foreign country is hereby requested for the above-identified patent application and the priority provided in 35 U.S.C. §119 is hereby claimed:

Patent Application No. 03024665.6 filed on October 27, 2003 in Finland

In support of this claim, a certified copy of said original foreign application is filed herewith.

It is requested that the file of this application be marked to indicate that the requirements of 35 U.S.C. §119 have been fulfilled and that the Patent and Trademark Office kindly acknowledge receipt of this document.



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Bezeichnung der Erfindung/Title of the invention/Titre de l'invention:
(Falls die Bezeichnung der Erfindung nicht angegeben ist, siehe Beschreibung.
If no title is shown please refer to the description.
Si aucun titre n'est indiqué se referer à la description.)

Enhanced local AAA redirector

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Title of the invention

Method, system, and network entities for processing
service requests in a domain of a domain-based network

5

Field of the invention

The present invention relates to a method, a system, and
network entities for processing service requests in a
10 domain of a domain-based network. In particular, such a
domain-based network consists of a plurality of domains
and may be exemplified by the Internet or a Third
Generation (3G) mobile communication network.

15 Background of the invention

In recent years, communication technology has widely
spread in terms of number of users and amount of use of
the telecommunication services by the users. This also
20 led to an increase in the number of different
technologies and technological concepts nowadays in use.
Additionally, the demands of users as well as the kind
and number of services has significantly increased. There
also exists a trend of merging different kinds of
25 networks providing different services into each other in
order to offer high comfort to the user and to integrate
these services into each other. For example, charging a
user for communication or used information services can
be performed by a specialized service/network which is
30 distinct from those services/network systems which are in
charge of enabling the communication as such via the
information network.

Many existing and future networks like the Internet are
35 organized in a domain-based manner. This means that the

whole network is constituted of a plurality of individual administrative areas, which are known as domains or realms. Each such domain covers a relatively small region, but by an inter-connection of many of such domains, the whole network can achieve an enormous coverage in terms of area and users. Additionally, each such domain itself can again be organized in a domain-based manner being constituted of so-called sub-domains. Such a network configuration represents a hierarchical structure and is advantageous for administration and operation of a large amount of users.

The individual domains are built up, organized and managed by a respective service provider, and they are organizationally confined and independent but interconnected with each other.

A popular example for such a domain-based network is the Internet with the Internet service providers (ISP) providing individual inter-connected networks representing the domains. In this context, the term of a user's or user terminal's 'home domain' means the particular domain of the ISP with which a user or user terminal is registered. The well-known address format for Internet communications therefore is *username@homedomain*.

In a domain-based network arrangement as described above, each service provider basically provides for communication or information services for the users registered with him. Today, however, there exist many security relevant and/or user-related services which makes the provision of security aspects such as authentication and authorization mandatory in communication networks. Many future Internet services or mobile communication services will also require such

functions. The rules and directives to be followed by users having access to databases, systems and resources can be summarized by the term „security policy“. If a user, for example, wants to use a security-relevant service of another service provider, the user has to authenticate and/or authorize himself. For this purpose, he needs a password, a security key or the like. Such information can be managed in a centralized way or by a specialized network or part of a network providing such user-related services.

Additionally, the aforementioned inter-connection of domains enables a user to utilize services of service providers different from his own service provider and also within domains different from his home domain. This feature is often referred to as roaming and makes an additional accounting functionality necessary, for example, in order to gather billing, auditing and reporting information about the „visiting“ user.

Conventionally, a specialized network for performing such functions as described above is built up „on top of“ the communication network, and is often referred to as AAA (authorization, authentication and accounting) network. The thus realized functions like system access and database look-ups can take place in specific and separate AAA nodes, but in practice, these nodes are often implemented within the nodes of the underlying communication network, which has the advantage of a joint use of hardware and thus reduced costs. Notwithstanding the hardware location, the AAA nodes offer a functionality which is distinct from other functionalities. Therefore, in the following specification a node is individually addressed as long as

it provides a distinct functionality irrespective of its physical location or implementation.

For the sake of clarity and simplicity, it will
5 hereinafter only be referred to AAA nodes. The structure of the AAA network is also in line with the underlying communication network like the Internet or a 3GPP network. More specifically, an AAA network servicing a domain-based communication network is also organized in a
10 domain-based manner.

The use of AAA techniques provides as benefits an increased flexibility and control, scalability, and the usage of standardized authentication methods. However,
15 specialized security and routing protocols are also needed for performing AAA functions properly and for routing respective messages related to AAA functions. Examples for such standardized AAA protocols, which are known to a skilled person, include RADIUS (Remote Access
20 Dial-In User Services) which is standardized by the IETF (Internet Engineering Task Force), TACACS+ (Terminal Access Controller Access System) implemented by Cisco®, and Kerberos. These protocols are used for dial-in and terminal server access to the AAA network mainly from
25 outside the domain. As an example, a user roaming in a domain of another service provider than his own provider has to authenticate himself within this domain. Therefore, he sends a request to an AAA node within his home domain for providing him with the required services
30 like a password. Recently, the AAA Working Group of the Internet Engineering Task Force (IETF) is under way of standardizing a new RADIUS-based AAA protocol called Diameter.

The subsequent description focuses on the use of the Diameter protocol for these purposes of AAA. However, this serves as an example only and the principles underlying the present invention are also applicable to domain-based networks operating under another protocol as long as this other protocol is similar to the Diameter protocol and supports or is compatible to at least the routing functionality offered by Diameter.

10 The Diameter base protocol provides a session-oriented and policy-based framework for the functionality of Diameter routing of messages called (AAA) service requests. It is based on the nowadays commonly used challenge-response-type RADIUS protocol which is located
15 at the network layer of the OSI network model. Diameter dial-up services are, for example, further on based on PPP (Point-to-Point Protocol) connections, but roaming support is enhanced, and the Mobile IP model is integrated, making Diameter the AAA protocol for the
20 future. The terminology defined by the IETF in the version of the Internet draft which was found on their website at <http://www.ietf.org/internet-drafts/draft-ietf-aaa-diameter-17.txt> on August 20, 2003 will form the basis for the terms used in the further specification.

25 Hitherto, when large amounts of users are administered by a service provider, i.e. within an individual domain, it is reasonable to deploy the AAA network in a hierarchical way. Fig. 1 shows such a hierarchical AAA deployment in a domain-based manner. In the following, the structure and
30 operation of the system according to Fig. 1 will be described. In Fig. 1, the dashed lines represent bidirectional connections between entities being linked by these lines, and the dash-dotted lines indicate the

administrative areas, i.e. the boundaries of the domains, operated by a respective service provider.

As can be seen in Fig. 1, a domain-based network
5 generally comprises of a plurality of domains Dom_A, Dom_B, Dom_C, each of which is respectively administered by a separate service provider A, B, C. Although there are three such domains of three service providers shown in Fig. 1, such a network may comprise any number of
10 domains. In between all domains, i.e. not belonging to an administrative sphere of one service provider, there can also exist network nodes. As an example, an AAA redirector R, the usage of which will be explained below, is depicted in Fig. 1.

15 Domains can be expected to have the same basic constitution. Hence, only domain A is described and a similar description of domains B, C is omitted.

20 Further, the hierarchical structure of an AAA network within a domain of service provider A is shown in detail in Fig. 1. The highest hierarchy layer consists of an entry node A1 of the domain Dom_A, e.g. an AAA proxy, which serves as an interface between this and other
25 domains. This entry node is, therefore, connected to the AAA redirector R between all domains, to entry nodes B1, C1 of other domains, and to nodes of a lower hierarchy layer of Dom_A. In this second hierarchy layer, a plurality of service nodes A3a, A3b, A3c, e.g. AAA
30 servers are located which provide the above-mentioned user-related services such as AAA services. As can be seen in Fig. 1, these service nodes are connected to each other. In a third hierarchy layer, a plurality of access nodes A3a1, A3a2; A3b1, A3b2; A3c1, A3c2 is connected to
35 each respective service node A3a; A3b; A3c. A user can

access the network via these access nodes (AR: access router).

It is to be noted that throughout the following
5 description the term „user“ shall always to be understood either as the user itself or as a user terminal by means of which the respective user connects to the network.

Each user registered with service provider A, i.e. in
10 this domain Dom_A, is fixedly associated with one of the plurality of service nodes A3a, A3b, A3c, e.g. AAA server Beijing. The respective service node (also known as 'home server' of this user) manages method lists containing user and service information needed for the operation of
15 the AAA functions related to this user. For example, policy information for authorization like passwords and security keys of a user for a special service is stored in these methods lists. A user being associated with AAA server Beijing A3a, for example, is assumed to access the
20 network via an access node connected to this service node, e.g. AR Beijing1 A3a1 or AR Beijing2 A3a2.

The above structure also applies to AAA networks in other domains Dom_B, Dom_C, which is indicated by displaying
25 the respective entry nodes (B1, C1).

AAA-related service requests intended for other domains exit the domain through the entry node A1 of the domain in which domain they are originated, and are transmitted
30 to the AAA redirector R representing a domain-independent entity. In general, redirectors refer clients to servers and allow them to communicate directly. More specifically, redirectors obtain destination information for messages in order to enable a correct routing and
35 forwarding of these messages. Since redirectors are

generally not located in the forwarding path, they do not alter any information fields in the service request being handled. Service requests that are handled by an entry node B1 of a domain B and aim to a domain A (which is
5 unknown to domain B) are rather forwarded to the redirector R for obtaining information about the destination domain A. The redirector finds out the address of the entry node A1 of the desired domain A. It then sends back the required information on how to reach
10 the addressed domain A to the entry node B1. Then, entry node B1 is enabled to forward the service request to entry node A1.

AAA-related messages, i.e. AAA service requests, coming
15 from outside the domain of service provider A are handled locally by the entry node A1. The incoming message usually contains the destination domain and the user name for whom AAA functions are requested. The handling of the service request thus comprises a look-up of the
20 destination host ('home server') of this user, i.e. a service node A3a, A3b, A3c, in a user database, and a subsequent forwarding of the service request to the AAA server with which the respective user is associated.

25 Fig. 2 is an illustration showing the internal protocol structure of nodes of domain A according to Fig. 1. In detail, the entry node A1, two service nodes A3a, A3c and two access nodes A3a2, A3c1, one in connection with each service node, are shown as an example. It can be seen
30 that the internal structure in terms of an implemented protocol stack, e.g. the protocol stack of the Diameter base protocol, of each of these nodes is comparable. In this regard, each of these nodes comprises a transport layer, a peer FSM layer, a session FSM layer, and an
35 application layer of the respective security protocol (in

this case, Diameter). Further, it can be seen that the physical connections between the nodes are established between the respective transport layers. Since a skilled person knows the functions of each layer, a detailed
5 description thereof is omitted here.

Fig. 3 shows a home server (destination) determination procedure in response to an AAA service request according to the prior art. The illustration differs from the
10 illustration of Fig. 2 in that the processing of an incoming service request is shown by the numbered arrow lines. The exemplary procedure refers to a user being associated with a service node with the address
aaa.beijing.china.com, which user is roaming in another
15 domain and has originated a service request from there.

The incoming service request (solid arrow line from the right edge) is (1) input to and processed by the peer FSM (finite state machine) layer of the local AAA proxy, i.e.
20 the entry node A1. The service request is further transfers to the application layer of the entry node A1. The application layer handles a look-up (2), which is indicated by a dashed arrow line, in a user database DB_A for obtaining the required destination information. The
25 result of this look-up is included into the service request, again processed (3) in the application layer and transferred to the peer FSM layer. The thus adapted service request is then, based on the information retrieved from the database and included (3) in the
30 service request, forwarded (4) to the destination service node (home server) of the user under discussion. At the server, in this example aaa.beijing.china.com, the service request is finally processed in the peer FSM layer of service node A3a and transferred to the
35 application layer for providing the required service,

e.g. XXX. The access node, in this example
beijing2.beijing.china.com A3a2, via which the user under
discussion would access the network, if he was not
located in a foreign domain, is not involved in this
5 procedure.

However, the AAA deployment described above has some
problems and drawbacks in practice.

10 First, the local handling of all incoming messages by the
proxy, i.e. the performing of the database look-up and
the processing through a multitude of protocol layers, is
problematic. Every user being associated with a domain
and currently roaming in a foreign domain has to send a
15 service request back to his home domain, if he needs an
AAA service. Especially, when large amounts of users are
registered in service provider A's domain, it is likely
that many users of this service provider are roaming in
other domains at the same time (taking into consideration
20 a high mobility of users). The entry node of domain A can
then easily be loaded over burden due to many service
requests being input in a short time interval. This can
delay the required operation which is unacceptable under
today's communication requirements.

25 Second, there occurs a problem, when several service
nodes share the same domain name, e.g. china.com for
service nodes aaa.beijing.china.com and
aaa.hongkong.china.com, which is the case in the above-
30 described example. Such a scenario is comparable to the
above-mentioned sub-domains. In this case, users are not
likely to specify their service nodes with which they are
associated (home servers) when they roam under another
service node within their home domain. Since the
35 necessary redirect actions are, according to prior art,

based on the domain name and user name only, this would lead to a problem in the processing of such intra-domain service requests.

5 Summary of the invention

Consequently, it is an object of the present invention to remove the above drawbacks inherent to the prior art and to provide an improved system for processing service
10 requests in a domain of a domain-based network. Also, it is an object of the present invention to provide a method for processing service requests in a domain of a domain-based network. Additionally, it is an object of the present invention to provide network devices capable of
15 being used within the system of the present invention and of performing the method of the present invention.

According to a first aspect of the present invention, the above objects are achieved by a method for processing
20 service requests in a domain of a network which network consists of a plurality of domains, wherein said service requests originate from a user terminal associated with a service node of said domain, and wherein a domain at least comprises a service request input node, an
25 intermediate node, a database, an entry node, and a plurality of service nodes, and wherein said service request input node is connected to said intermediate node, to said entry node and to said service nodes, said intermediate node is further connected to said database
30 and to said service nodes, and said service nodes are further connected to each other; said method comprising the steps of: analyzing an incoming service request in said service request input node in terms of destination information contained in said service request;
35 determining in said service request input node, whether

the destination information enables a direct forwarding of said service request to its destination; redirecting said service request by said service request input node, if said determining yields that said direct forwarding is not enabled; wherein said redirecting comprises the steps of: transmitting said received service request by said service request input node to said intermediate node; based on said received service request, performing a look-up in said database by said intermediate node for obtaining destination information required to enable a forwarding of said service request to its destination; sending said destination information from said intermediate node to said service request input node by; and based on said sent destination information, forwarding said service request from said service request input node to its destination.

According to further advantageous aspects:

- the method further comprises a step of direct forwarding said service request by said service request input node to its destination, if said determining yields that said direct forwarding is enabled;
- said service request input node is an entry node of said domain, and said entry node receives said service request from outside of said domain;
- said service request input node is one of a plurality of service nodes of said domain, with which the user terminal originating said service request is not associated, wherein said one of the plurality of service nodes receives said service request from within said domain;
- said service request input node determines that the received service request from within said domain is destined for a user terminal being associated with a

service node of said domain, and in response thereto redirects said service request;

- said service request input node determines that the received service request from within said domain is
- 5 destined for a user terminal not being associated with a service node of said domain, and forwards said service request to said entry node of said domain for relaying said service request to another domain;
- said entry node of said domain is a proxy node; and
- 10 - said entry node of said domain is a relay node.

According to another aspect of the present invention, the above objects are achieved by a system for processing service requests in a domain of a network which network

15 consists of a plurality of domains, wherein said service requests originate from a user terminal associated with a service node of said domain, and wherein a domain at least comprises a service request input node, an intermediate node, a database, an entry node, and a

20 plurality of service nodes, and wherein said service request input node is connected to said intermediate node, to said entry node, and to said service nodes, said intermediate node is further connected to said database and to said service nodes, and said service nodes are

25 further connected to each other; said system comprising: analyzing means in said service request input node which analyze an incoming service request in terms of destination information contained in said service request; determining means in said service request input

30 node which determine, whether the destination information enables a direct forwarding of said service request to its destination; redirecting control means in said service request input node which control a redirecting of said service request, if said determining means yields

35 that said direct forwarding is not enabled; wherein said

redirecting is performed by: transmitting means in said service request input node which transmit said received service request from said service request input node to said intermediate node; look-up means in said
5 intermediate node which perform, based on said service request received by receiving means, a look-up in said database for obtaining destination information required to enable a forwarding of said service request to its destination; sending means in said intermediate node
10 which send said destination information from said intermediate node to said service request input node; and forwarding means in said service request input node which forward said service request, based on said sent destination information, from said service request input
15 node to its destination

According to further advantageous aspects:

- 20 - the system further comprises forwarding means in said service request input node which forward said service request to its destination, if said determining means yields that said direct forwarding is enabled;
- said service request input node is an entry node of said domain, and said entry node receives said service
25 request from outside of said domain;
- said service request input node is one of a plurality of service nodes of said domain, with which the user terminal originating said service request is not associated, wherein said one of the plurality of service
30 nodes receives said service request from within said domain;
- said service request input node comprises determining means which determine, whether the received service request from within said domain is destined for a user
35 terminal being associated with a service node of said

domain, and redirecting means which redirect said service request, if said service request is destined for a user terminal being associated with a service node of said domain;

- 5 - said service request input node comprises determining means which determine, whether the received service request from within said domain is destined for a user terminal not being associated with a service node of said domain, and forwarding means which forward said service
- 10 request to said entry node of said domain for relaying said service request to another domain, if said service request is destined for a user terminal not being associated with a service node of said domain;
- said entry node of said domain is a proxy node; and
- 15 - said entry node of said domain is a proxy node.

According to another aspect of the present invention, the above objects are achieved by an intermediate node which redirects service requests within a domain of a network

20 which network consists of a plurality of domains, wherein said intermediate node is connected to an entry node, to a database, and to a plurality of service nodes of said domain; said intermediate node comprising: (a) receiving means which receive said service request from a service

25 request input node; (b) look-up means which perform, based on said received service request, a look-up in said database for obtaining destination information required to enable a forwarding of said service request to its destination; (c) sending means which send said

30 destination information from said intermediate node to said service request input node.

According to another aspect of the present invention, the above objects are achieved by a service node of a domain

35 of a network which network consists of a plurality of

domains, wherein said service node provides services for a user terminal associated with said service node, which services are requested by service requests originating from said user terminal, wherein said service node is
5 connected to an entry node of said domain, to an intermediate node of said domain which redirects service requests within said domain, and to all other service nodes of said domain.

10 According to another aspect of the present invention, the above objects are achieved by a service request input node within a domain of a network which network consists of a plurality of domains, wherein said service request
15 input node processes service requests originated from user terminals of said network, and wherein said service request input node is connected to an intermediate node of said domain which redirects service requests within a domain, and to a plurality of service nodes of said domain; said service request input node comprising:
20 redirecting control means which control a redirecting of a received incoming service request; transmitting means which transmit said received service request to said intermediate node for obtaining destination information required to enable a forwarding of said service request
25 to its destination; forwarding means which forward said service request, based on said received destination information, from said service request input node to its destination.

30 According to further advantageous aspects:

- said service request input node is an entry node of said domain, and receives said service requests from outside of said domain;

- said service request input node is a service node of said domain, and receives said service requests from within said domain;
 - the service request input node further comprises
- 5 determining means which determine, whether the received service request from within said domain is destined for a user terminal being associated with a service node of said domain, and redirects said service request, if said service request is destined for a user terminal being
- 10 associated with a service node of said domain;
- the service request input node further comprises determining means which determine, whether the received service request from within said domain is destined for a user terminal not being associated with a service node of
- 15 said domain, and forwarding means which forward said service request to an entry node of said domain for relaying said service request to another domain, if said service request is destined for a user terminal not being associated with a service node of said domain.

20 Furthermore, advantageous aspects of the present invention include that said service requests are AAA service requests associated with authentication, authorization, and accounting functions, and that service

25 requests are processed based on the Diameter base protocol.

Furthermore, advantageous aspects of the present invention include that the network consisting of a

30 plurality of domains is the Internet and the domains are established by respective service providers, or that the network consisting of a plurality of domains is a 3G mobile communication network

An advantage of the present invention is the provision of a mechanism to process incoming messages to a correct service node within the hierarchy of nodes of a domain of a network which consists of a plurality of domains. This
5 can be performed with least spending of an entry node and with no modifications to the utilized protocol. In particular, the requirements on an entry node are alleviated in that it is possible to replace a proxy implementation by a relay implementation. This saves cost
10 and implementation effort and can improve the robustness of the system.

It is a further advantage of the present invention that roaming within sub-domains, i.e. roaming under another
15 service node within a home domain of a user, is easy to achieve. Even when new (e.g., Diameter) applications are adopted, no update to the entry node is needed.

Furthermore, it is an advantage of the present invention
20 that the burden of an entry node when handling service requests can be reduced, a redirecting function within a domain is implemented, and such a solution can be deployed in the cascade way within a very large hierarchical framework.

25 Yet another advantage is that the use of a centralized roaming user management is possible.

Brief description of the drawings

30 In the following, the present invention will be described in greater detail with reference to the accompanying drawings, in which

Fig. 1 shows a hierarchical AAA deployment in a domain-based manner according to the prior art;

5 Fig. 2 is an illustration showing the internal protocol structure of nodes of a domain according to Fig. 1.

Fig. 3 shows a destination determination procedure in response to an AAA service request according to the prior art.

10

Fig. 4 shows a node deployment with a local redirector within a domain of a domain-based network according to the present invention.

15 Figs. 5A to 5D show examples of routing tables of a redirector and an entry node, each according to the prior art and to the present invention.

20 Fig. 6 shows a destination determination procedure in response to a service request according to the present invention.

Fig. 7 shows a more detailed destination determination procedure according to Fig. 6 with contents of respective messages being exchanged during the procedure.

25

Fig. 8 shows a block diagram of an internal structure of network nodes according to the present invention.

30 Detailed description of an embodiment of the present invention

It is to be noted that the present invention will be described with a specific focus on the usage of an AAA network and the Diameter base protocol specified by the

35

IETF AAA Working Group as the underlying AAA protocol. Nevertheless, the present invention is not limited to either of both but is also applicable to other types of domain-based networks (e.g. operation and management networks of mobile communication networks) providing user-related services and protocols therefor, e.g. RADIUS, as long as these other protocols are similar to the Diameter protocol and support or are compatible to at least to the routing functionality offered by Diameter.

Furthermore, the underlying domain-based communication network is herein exemplary described to be the Internet. However, any other domain-based communication network is conceivable, such as a 3G mobile communication system.

According to an embodiment of the present invention, Fig. 4 shows a node deployment with a local redirector within a domain of a domain-based network according to the present invention.

Basically, the illustration of Fig. 4 according to the present invention corresponds to the illustration of Fig. 1 according to the prior art. Namely, Fig. 4 only shows the domain Dom_A of service provider A. Consequently, entities with like reference signs than that of Fig. 1 represent comparable entities and their description will be omitted.

A so-called „enhanced local AAA redirector“ is newly introduced into the network topology within this domain. This redirector denoted with A2 will hereinafter be referred to as an intermediate node since it is located in between the entry node A1 representing a first hierarchy layer and the service nodes A3a, A3b, A3c representing a second hierarchy layer. The intermediate

node A2 is connected to the entry node, to a database (not shown) and to all service nodes A3a, A3b, A3c. It is adapted to provide and/or provides a redirecting function within domain Dom_A. A detailed description of such a
5 local redirecting function will follow with reference to Figs. 6 and 7.

It is to be noted that domain Dom_A serves as an example and that everything in this regard may also apply to any other domain of the network.

10

The present invention utilizes a routing function of an underlying AAA protocol, e.g. the Diameter base protocol routing function, to achieve efficient processing of (AAA) service requests. Further, the present invention
15 utilizes the function of redirecting which is adapted to be and/or is available for processing of service requests within each domain of the domain-based network, irrespective of a redirecting function in-between different domains as is provided by redirector R
20 according to the prior art.

In the present invention, the redirect procedure is adopted in such a way that unrecognized service requests, i.e. service requests in which the destination service
25 node is not specified, are handled by the above-mentioned intermediate node A2. The intermediate node A2 then obtains the appropriate destination service node for the service request by performing a database look-up in a user database to find out the destination service node
30 for the user originating the service request. It then sends back the respective information to the node from which it received the service request, and the service request will be forwarded by this node on the basis of its destination information. The redirect actions
35 according to the present invention are based on the

domain name and on the user name as known from the prior art. However, the redirect function according to the present invention is performed below the application layer of the protocol, e.g. the Diameter application
5 layer. In the following, the such enhanced functionality will be explained in detail.

Therefore, Figs. 5A to 5D show examples of routing tables of a redirector and an entry node, each according to the
10 prior art and to the present invention.

A conventional domain-independent redirector redirects messages according to its domain-based routing table as the one shown in Fig. 5A, for example. It can be seen
15 that the source domain (or source realm) does not have any influence on the routing procedure and can, hence, be arbitrary (*). A message with target domain (or target realm) *finland.com*, for example, will be handled according to the respective action, i.e. redirect. Thus,
20 this message will be redirected to the node specified as next hop, i.e. the entry node of the respective domain *finland.com*, e.g. *entry.finland.com*. In case a domain has one or more further entry nodes than the one specified as next hop, these are specified as alternative redirect-
25 hosts. If one entry node is not in operation or can not be reached due to a connection failure or the like, the message will be redirected to this alternative redirect-host, e.g. *entryway.moon.com* for domain *moon.com*.

30 In the perspective of the redirector with the above referenced routing table, all target domains are foreign domains since the redirector is located outside of all domains as described above with regard to the prior art deployment (see Fig. 1).

The enhanced local redirector according to the present invention is part of the domain of a service provider, and thus there also exists a *localdomain* from its perspective. If the target domain is *localdomain*, i.e. the home domain of the user originating the service request is equal to the home domain of the redirector, the message can not be redirected in a conventional way due to a lack of an appropriate action in the conventional routing table of Fig. 5A. Therefore, when adopting the present invention, the routing table of Fig. 5A is adapted in the way shown in Fig. 5B, i.e. an action „orient“ is to be added for the case of target realm being *localdomain*.

Then, the message is „oriented“ to a user database (not shown) of this domain, e.g. *userDB.localdomain.com*. This newly introduced „orient“ action initiates the look-up in the user database server and the querying of the destination service node for the user being specified by the current service request.

A detailed description and explanation of the method of redirecting service requests will be given in the following by means of two examples.

[First example]

In a first example, the following problem is dealt with. When a user is roaming in a foreign domain, a service request will be sent back to the user's home domain, if the user requires a user-related (AAA) service. As, for example, the Diameter base protocol for AAA networks suggests, the request will according to the prior art be handled locally by the entry node. The corresponding

routing table of such a conventional entry node is shown in Fig. 5C.

Yet, such local processing could easily cause the node
5 being loaded over burden, if there are a lot of requests
coming in at a time. In this regard, it is to be noted
that the service request has also to be analyzed before
its processing with respect to redirecting. Additionally,
the domain entry node in a domain that has more than one
10 service node would be puzzled since the incoming service
request does not explicitly specify the destination host
(destination service node). For being able to perform a
redirect function, the node would have to modify the
message after querying the database for the destination
15 host. By doing so, the security measures adopted, e.g. by
the Diameter application, would be violated because the
entry node sits in the forwarding path and is therefore
not allowed to modify incoming service requests. Thus,
this solution is not feasible.

20
In this example, according to the invention, when the
entry node receives a service request from a outside of
its domain, it will not process it locally as known from
the prior art. Rather, the service request lacking
25 destination information will be transmitted to a local
redirector of the *localdomain* for further instructions
and/or information. Therefore, the domain-based routing
table for the entry node is modified according Fig. 5D.
Therein, a message for the *localdomain* will be relayed to
30 a local redirector, e.g. *redirector.localdomain.com*,
which performs the redirecting function according to the
routing table of Fig. 5B.

Fig. 6 shows a destination determination procedure in
35 response to a service request coming from outside a local

domain according to the first example of the present invention.

Basically, Fig. 6 corresponds to Fig. 3 in that these
5 figures are based on the same scenario. However, the two
nodes of Fig. 3 constituting the lower branch on the left
side, i.e. service node A3c and access node A3c1, are
omitted, and an intermediate node A2, i.e. an enhanced
local AAA redirector, is newly introduced. It can be seen
10 that the procedural steps (1) and (4) are comparable, but
that procedural steps (2) and (3) clearly differ when
comparing Fig. 3 according to the prior art and Fig. 6
according to the invention.

15 After receiving (1) of the service request in the peer
FSM layer of the entry node A1, the service request is
analyzed in terms of destination information contained in
the service request. Upon this analyzing, it is
determined, whether the destination information enables a
20 direct forwarding of the service request to its
destination. If said determining yields that said direct
forwarding is enabled, the service request will be
forwarded by the entry node directly to its destination,
e.g. service node *aaa.beijing.china.com*. In this case,
25 e.g. when the destination information contained in the
service request enable a direct forwarding, a redirecting
of the service request under discussion is not performed.

However, if said determining yields that said direct
30 forwarding is not enabled, the service request will be
redirected, and such redirecting is performed as follows.

In the redirecting process, the service request is not
transferred to the application layer of the entry node A1
35 to be processed locally, but it is processed according to

the routing table of the entry node according to the present invention (see Fig. 5D). Accordingly, the service request is relayed to the local redirector, i.e. transmitted (2) to the peer FSM layer of the intermediate node A2. From thereon, a database look-up is performed according to the routing table of the local redirector according to the present invention (see Fig. 5B), i.e. the service request is oriented to the user database. The look-up is based on the received service request and is performed for obtaining destination information requires to enable a forwarding of this service request to its destination. The result of the look-up, i.e. the destination information for the respective service request, is received at the peer FSM layer of the intermediate node A2, and sent (3) from the intermediate node A2 to the peer FSM layer of the entry node A1. From there, the modified service request is, based on the sent destination information, forwarded (4) to its destination, namely service node *aaa.beijing.china.com*. The respective access node, namely *beijing2.beijing.china.com*, is again not involved in the processing of this service request.

In prior art, the entry node is often implemented by using a proxy node. According to the invention, the upper two layers of the protocol stack of the entry node are not involved any more for the processing of incoming messages as described above. This alleviates the requirements on the node. Thus, it is also possible to replace the proxy by a simple relay node and the policy processing can be handled in the local service node against the user's locale profile. This saves costs and implementation effort and can improve the robustness of the system.

In Fig. 7, the destination determination procedure according to Fig. 6 is shown with greater detail in that the contents of respective messages being exchanged during the procedure are shown. The left part of Fig. 7 differs from Fig. 6 only in that the two upper protocol layers of the entry node A1, i.e. the session FSM layer and the application layer, are not shown since these are not involved any more in connection with the present invention, and that the access node A3a2 is not shown. In the following, the procedure will be described again with regard to the messages being exchanged and their contents.

In this scenario, *china.com* is the *localdomain* under inspection, and the user *liuqing* being associated to the service node *aaa.beijing.china.com* originated a service request from a foreign domain to his/her home domain. This request (REQ) message (Message 1) being input to the entry node A1 of domain *china.com* contains the information that *china.com* is the destination domain and that *liuqing* is the concerned user name. The message is transmitted to the intermediate node A2 for further instruction because it does not specify the destination service node (destination host) for the user *liuqing*. This is also the case here since the present invention does not modify the underlying protocol. With the updated routing table of the entry node (see Fig. 5D), *redirector.china.com* is introduced into the service request (Message 2) as (temporary) destination host. The other information fields remain unchanged.

The intermediate node named *redirector.china.com* detects its local domain *china.com* as destination domain (see Fig. 5B) and, therefore, queries a database for the home service node (host) for the user *liuqing* by a look-up

into the user database DB_A of the domain *china.com*. The intermediate node then replies the result of the look-up to the entry node A1 by sending an error (ERR) message (Message 3). This error message contains not only the destination domain and user name like above, but additionally contains an information in the redirect host field, namely *aaa.beijing.china.com*, i.e. the service node (for the user concerned) to which the service request is to be redirected. The service request is then updated with this new information, i.e. destination host is changed from its temporary assignment *redirector.china.com* into the actual destination service node of the user *liuqing* which is *aaa.beijing.china.com*. At this point, the entry node forwards the accordingly adapted service request (Message 4) to the destination service node (destination host) of the user under discussion, and the processing of the service request is completed as known from the art.

The exemplary messages of Fig. 7 correspond to message formats (e.g., REQ, ERR) known from the Diameter base protocol. The respective information is shown to be contained in predetermined information fields (e.g. destination-realm, user-name) within such messages, so-called attribute-value-pairs (AVP). However, other message formats and information fields being predetermined by other protocols can also be used when adapting the invention. Thus, the invention is not limited to the use of the Diameter base protocol.

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[Second example]

In a large domain, more than one service node prevails in this domain, and thus, different service nodes share the same domain name. In this example, a user being

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associated to a first service node, e.g.

aaa.beijing.china.com A3a currently accesses the network via an access node, e.g. *hongkong1.hongkong.china.com*

A3c1 which is connected to a second service node, e.g.

5 *aaa.hongkong.china.com* A3c, whereby this second service node has the same domain name as the first one, namely *china.com*. Such a scenario is also known as intra-domain or sub-domain roaming. A service node receiving a service request from a user being associated with another service
10 node of the same domain would then be puzzled since the service request of such a roaming user does not specify the destination service node (home server) of the user. And users are not likely to specify their home service node when they roam under another service node within
15 their home domain. Such a service request would only contain the home domain and the user name. However, this would according to the prior art result in a processing of the service request in the entry node of the domain.

20 However, utilization of the entry node, which is deployed at the boundary of the administrative domain, is not preferable to handle roaming within sub-domains. Especially with a Diameter implementation, the routing decisions should be made within the Diameter base
25 protocol and not by defining respective Diameter applications. It would therefore introduce too much implementation efforts if the entry node is used to handle many Diameter applications, which would be the case when handling of sub-domain roaming would take place
30 in the entry node.

In this example, one of a plurality of service nodes of a respective domain, with which the user originating the service request is not associated receives the service
35 request from within this domain. According to the present

invention, when a service node receives such an „unrecognized“ service request for the local domain, it transmits the request to an intermediate node according to the invention for providing a redirecting function.

- 5 The redirector then detects *localdomain* to be the target domain and, thus, relays the request with the domain name and the user name to the user DB server as is already described in the first example. The following procedure is the same as described above.

10

From this second example, it can be seen that a service request can be input to different nodes of a network, i.e. an entry node for service requests coming from outside the domain and a service node for service

- 15 requests coming from within the domain, each being an example representing a „service request input node“ within the framework of the present definitions of terminology adopted in the present specification. The basic internal structures of such a service request input
20 node and an intermediate node according to the present invention are shown in the block diagram of Fig. 8.

- In Fig. 8, a service request input node is exemplary shown as an entry node A1. Thereby, solid arrow lines
25 represent the process of messages (i.e., service request and database inquiry message), whereas the dashed arrow lines represent control connections.

- A service request input node, irrespective of whether it
30 is an entry node or a service node, receives and processes an incoming service request and controls the local redirecting function. Thus, it comprises analyzing means A11, determining means A12, redirecting control means A13, transmitting means A14, and forwarding means
35 A15. Thereby the analyzing means A11 analyze an incoming

service request in terms of destination information contained therein, the determining means A12 determine, whether the destination information enables a direct forwarding of the service request to its destination, the
5 redirecting control means A13 control a redirecting of a service request, if the determining means yield that said direct forwarding is not enabled, and the transmitting means A14 then transmit the received service request to an intermediate node A2. The forwarding means A15 either
10 forward the service request directly to its destination, if the determining means yield that such direct forwarding is enabled, or forward based on the destination information sent by an intermediate node, the service request to its destination as part of a
15 redirecting procedure.

Furthermore, an intermediate node according to the invention comprises receiving means A21 which receive a service request from a service request input node, look-
20 up means A22 which perform, based on the service request, a look-up in a database DB_A for obtaining destination information required to enable a forwarding of the service request to its destination, and sending means A23
25 which send the destination information to the service request input node from which the service request was received.

According to the present invention a method, a system and corresponding network entities for processing service
30 requests in a domain of a network which network consists of a plurality of domains are provided, which method comprising the steps of: analyzing an incoming service request in a service request input node in terms of destination information contained in said service
35 request; determining in said service request input node,

whether the destination information enables a direct forwarding of said service request to its destination; redirecting said service request by said service request input node, if said determining yields that said direct forwarding is not enabled; wherein said redirecting comprises the steps of: transmitting said received service request by said service request input node to an intermediate node; based on said received service request, performing a look-up in a database by said intermediate node for obtaining destination information required to enable a forwarding of said service request to its destination; sending said destination information from said intermediate node to said service request input node; and based on said sent destination information, forwarding said service request from said service request input node to its destination.

While the invention has been described with reference to a preferred embodiment, the description is illustrative of the invention and is not to be construed as limiting the invention. Various modifications and applications may occur to those skilled in the art without departing from the true spirit and scope of the invention as defined by the appended claims.

Claims

1. A method for processing service requests in a domain
(Dom_A) of a network which network consists of a
5 plurality of domains (Dom_A, Dom_B, Dom_C), wherein
said service requests originate from a user terminal
associated with a service node of said domain (Dom_A),
and wherein a domain (Dom_A, Dom_B, Dom_C) at least
comprises a service request input node (A1, A3a, A3b,
10 A3c), an intermediate node (A2), a database (DB_A), an
entry node (A1), and a plurality of service nodes (A3a,
A3b, A3c), and wherein said service request input node
is connected to said intermediate node (A2), to said
entry node (A1) and to said service nodes (A3a, A3b,
15 A3c), said intermediate node (A2) is further connected
to said database (DB_A) and to said service nodes (A3a,
A3b, A3c), and said service nodes (A3a, A3b, A3c) are
further connected to each other; said method comprising
the steps of:
- 20 analyzing an incoming service request in said
service request input node in terms of destination
information contained in said service request;
determining in said service request input node,
whether the destination information enables a direct
25 forwarding of said service request to its destination;
redirecting said service request by said service
request input node, if said determining yields that
said direct forwarding is not enabled; wherein said
redirecting comprises the steps of:
- 30 transmitting said received service request by said
service request input node to said intermediate node
(A2);
based on said received service request, performing
a look-up in said database (DB_A) by said intermediate
35 node (A2) for obtaining destination information

required to enable a forwarding of said service request to its destination;

5 sending said destination information from said intermediate node (A2) to said service request input node; and

 based on said sent destination information, forwarding said service request from said service request input node to its destination.

10 2. A method according to claim 1, further comprising a step of direct forwarding said service request by said service request input node to its destination, if said determining yields that said direct forwarding is enabled.

15

 3. A method according to claim 1 or 2, wherein said service request input node is an entry node (A1) of said domain (Dom_A), and wherein said entry node (A1) receives said service request from outside of said domain (Dom_A).

20

 4. A method according to claim 1 or 2, wherein said service request input node is one of a plurality of service nodes (A3a, A3b, A3c) of said domain (Dom_A), with which the user terminal originating said service request is not associated, wherein said one of the plurality of service nodes (A3a, A3b, A3c) receives said service request from within said domain (Dom_A).

25

30 5. A method according to claim 4, wherein said service request input node determines that the received service request from within said domain (Dom_A) is destined for a user terminal being associated with a service node (A3a, A3b, A3c) of said domain (Dom_A), and in response thereto redirects said service request.

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6. A method according to claim 4, wherein said service request input node determines that the received service request from within said domain (Dom_A) is destined for a user terminal not being associated with a service node (A3a, A3b, A3c) of said domain (Dom_A), and forwards said service request to said entry node (A1) of said domain (Dom_A) for relaying said service request to another domain (Dom_B, Dom_C).
7. A method according to any preceding claim, wherein said service requests are AAA service requests associated with authentication, authorization, and accounting functions.
8. A method according to claim 7, wherein service requests are processed based on the Diameter base protocol.
9. A method according to any of claims 3 to 8, wherein said entry node of said domain (Dom_A) is a proxy node.
10. A method according to any of claims 3 to 8, wherein said entry node of said domain (Dom_A) is a relay node.
11. A method according to any preceding claim, wherein the network consisting of a plurality of domains (Dom_A, Dom_B, Dom_C) is the Internet and the domains (Dom_A, Dom_B, Dom_C) are established by respective service providers (A, B, C).
12. A method according to any of claims 1 to 10, wherein the network consisting of a plurality of domains

(Dom_A, Dom_B, Dom_C) is a 3G mobile communication network.

13. A system for processing service requests in a domain
5 (Dom_A) of a network which network consists of a plurality of domains (Dom_A, Dom_B, Dom_C), wherein said service requests originate from a user terminal associated with a service node of said domain (Dom_A), and wherein a domain (Dom_A, Dom_B, Dom_C) at least
10 comprises a service request input node (A1, A3a, A3b, A3c), an intermediate node (A2), a database (DB_A), an entry node (A1), and a plurality of service nodes (A3a, A3b, A3c), and wherein said service request input node is connected to said intermediate node (A2), to said
15 entry node (A1), and to said service nodes (A3a, A3b, A3c), said intermediate node (A2) is further connected to said database (DB_A) and to said service nodes (A3a, A3b, A3c), and said service nodes (A3a, A3b, A3c) are further connected to each other; said system
20 comprising:

analyzing means (A11) in said service request input node which analyze an incoming service request in terms of destination information contained in said service request;

25 determining means (A12) in said service request input node which determine, whether the destination information enables a direct forwarding of said service request to its destination;

redirecting control means (A13) in said service
30 request input node which control a redirecting of said service request, if said determining means yields that said direct forwarding is not enabled; wherein said redirecting is performed by:

transmitting means (A14) in said service request
35 input node which transmit said received service request

from said service request input node to said intermediate node (A2);

look-up means (A22) in said intermediate node (A2) which perform, based on said service request received by receiving means (A21), a look-up in said database (DB_A) for obtaining destination information required to enable a forwarding of said service request to its destination;

sending means (A23) in said intermediate node (A2) which send said destination information from said intermediate node (A2) to said service request input node; and

forwarding means (A15) in said service request input node which forward said service request, based on said sent destination information, from said service request input node to its destination.

14. A system according to claim 13, further comprising forwarding means in said service request input node which forward said service request to its destination, if said determining means yields that said direct forwarding is enabled.

15. A system according to claim 13 or 14, wherein said service request input node is an entry node (A1) of said domain (Dom_A), and wherein said entry node (A1) receives said service request from outside of said domain (Dom_A).

16. A system according to claim 13 or 14, wherein said service request input node is one of a plurality of service nodes (A3a, A3b, A3c) of said domain (Dom_A), with which the user terminal originating said service request is not associated, wherein said one of the

plurality of service nodes (A3a, A3b, A3c) receives said service request from within said domain (Dom_A).

17. A system according to claim 16, wherein said service
5 request input node comprises determining means which
determine, whether the received service request from
within said domain (Dom_A) is destined for a user
terminal being associated with a service node (A3a,
A3b, A3c) of said domain (Dom_A), and redirecting means
10 which redirect said service request, if said service
request is destined for a user terminal being
associated with a service node (A3a, A3b, A3c) of said
domain (Dom_A).

15 18. A system according to claim 16, wherein said service
request input node comprises determining means which
determine, whether the received service request from
within said domain (Dom_A) is destined for a user
terminal not being associated with a service node (A3a,
20 A3b, A3c) of said domain (Dom_A), and forwarding means
which forward said service request to said entry node
(A1) of said domain (Dom_A) for relaying said service
request to another domain (Dom_B, Dom_C), if said
service request is destined for a user terminal not
25 being associated with a service node (A3a, A3b, A3c) of
said domain (Dom_A).

19. A system according to any of claims 13 to 18, wherein
said service requests are AAA service requests
30 associated with authentication, authorization, and
accounting functions.

20. A system according to claim 19, wherein service
requests are processed based on the Diameter base
35 protocol.

21. A system according to any of claims 15 to 20, wherein said entry node of said domain (Dom_A) is a proxy node.

5

22. A system according to any of claims 15 to 20, wherein said entry node of said domain (Dom_A) is a relay node.

10 23. A system according to any of claims 13 to 22, wherein the network consisting of a plurality of domains (Dom_A, Dom_B, Dom_C) is the Internet and the domains (Dom_A, Dom_B, Dom_C) are established by respective service providers (A, B, C).

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24. A system according to any of claims 13 to 22, wherein the network consisting of a plurality of domains (Dom_A, Dom_B, Dom_C) is a 3G mobile communication network.

20

25. An intermediate node (A2) which redirects service requests within a domain (Dom_A) of a network which network consists of a plurality of domains (Dom_A, Dom_B, Dom_C), wherein said intermediate node (A2) is connected to an entry node (A1), to a database (DB_A), and to a plurality of service nodes (A3a, A3b, A3c) of said domain; said intermediate node comprising:

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a) receiving means (A21) which receive said service request from a service request input node (A1, A3a, A3b, A3c);

30

b) look-up means (A22) which perform, based on said received service request, a look-up in said database (DB_A) for obtaining destination information required to enable a forwarding of said service request to its destination;

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c) sending means (A23) which send said destination information from said intermediate node (A2) to said service request input node.

- 5 26. An intermediate node according to claim 25, wherein said service requests are AAA service requests associated with authentication, authorization, and accounting functions.
- 10 27. A service node (A3a, A3b, A3c) of a domain (Dom_A) of a network which network consists of a plurality of domains (Dom_A, Dom_B, Dom_C), wherein said service node provides services for a user terminal associated with said service node, which services are requested by
15 service requests originating from said user terminal, wherein said service node is connected to an entry node (A1) of said domain (Dom_A), to an intermediate node (A2) of said domain (Dom_A) which redirects service requests within said domain (Dom_A), and to all other
20 service nodes of said domain (A3a, A3b, A3c).
28. A service node according to claim 27, wherein said service requests are AAA service requests associated
25 with authentication, authorization, and accounting purposes functions.
29. A service request input node within a domain (Dom_A) of a network which network consists of a plurality of
30 domains (Dom_A, Dom_B, Dom_C), wherein said service request input node processes service requests originated from user terminals of said network, and wherein said service request input node is connected to an intermediate node (A2) of said domain (Dom_A) which
35 redirects service requests within a domain (Dom_A), and

to a plurality of service nodes of said domain (Dom_A);
said service request input node comprising:

redirecting control means (A13) which control a
redirecting of a received incoming service request;

5 transmitting means (A14) which transmit said
received service request to said intermediate node (A2)
for obtaining destination information required to
enable a forwarding of said service request to its
destination;

10 forwarding means (A15) which forward said service
request, based on said received destination
information, from said service request input node to
its destination.

15 30. A service request input node according to claim 29,
wherein said service request input node is an entry
node (A1) of said domain (Dom_A), and receives said
service requests from outside of said domain (Dom_A).

20 31. A service request input node according to claim 29,
wherein said service request input node is a service
node (A3a, A3b, A3c) of said domain (Dom_A), and
receives said service requests from within said domain
(Dom_A).

25 32. A service request input node according to claim 31,
further comprising determining means which determine,
whether the received service request from within said
domain (Dom_A) is destined for a user terminal being
30 associated with a service node (A3a, A3b, A3c) of said
domain (Dom_A), and redirects said service request, if
said service request is destined for a user terminal
being associated with a service node (A3a, A3b, A3c) of
said domain (Dom_A).

35

33. A service request input node according to claim 31,
further comprising determining means which determine,
whether the received service request from within said
domain (Dom_A) is destined for a user terminal not
5 being associated with a service node (A3a, A3b, A3c) of
said domain (Dom_A), and forwarding means which forward
said service request to an entry node (A1) of said
domain (Dom_A) for relaying said service request to
another domain (Dom_B, Dom_C), if said service request
10 is destined for a user terminal not being associated
with a service node (A3a, A3b, A3c) of said domain
(Dom_A).
34. A service request input node according to any of
15 claims 29 to 33, wherein said service requests are AAA
service requests associated with authentication,
authorization, and accounting functions.

Abstract

A method, a system and corresponding network entities for processing service requests in a domain of a network
5 which network consists of a plurality of domains,
comprising the steps of: analyzing an incoming service
request in a service request input node in terms of
destination information contained in said service
10 request; determining in said service request input node,
whether the destination information enables a direct
forwarding of said service request to its destination;
redirecting said service request by said service request
input node, if said determining yields that said direct
15 forwarding is not enabled; wherein said redirecting
comprises the steps of: transmitting said received
service request by said service request input node to an
intermediate node; based on said received service
request, performing a look-up in a database by said
20 intermediate node for obtaining destination information
required to enable a forwarding of said service request
to its destination; sending said destination information
from said intermediate node to said service request input
node; and based on said sent destination information,
25 forwarding said service request from said service request
input node to its destination.

Fig. 4

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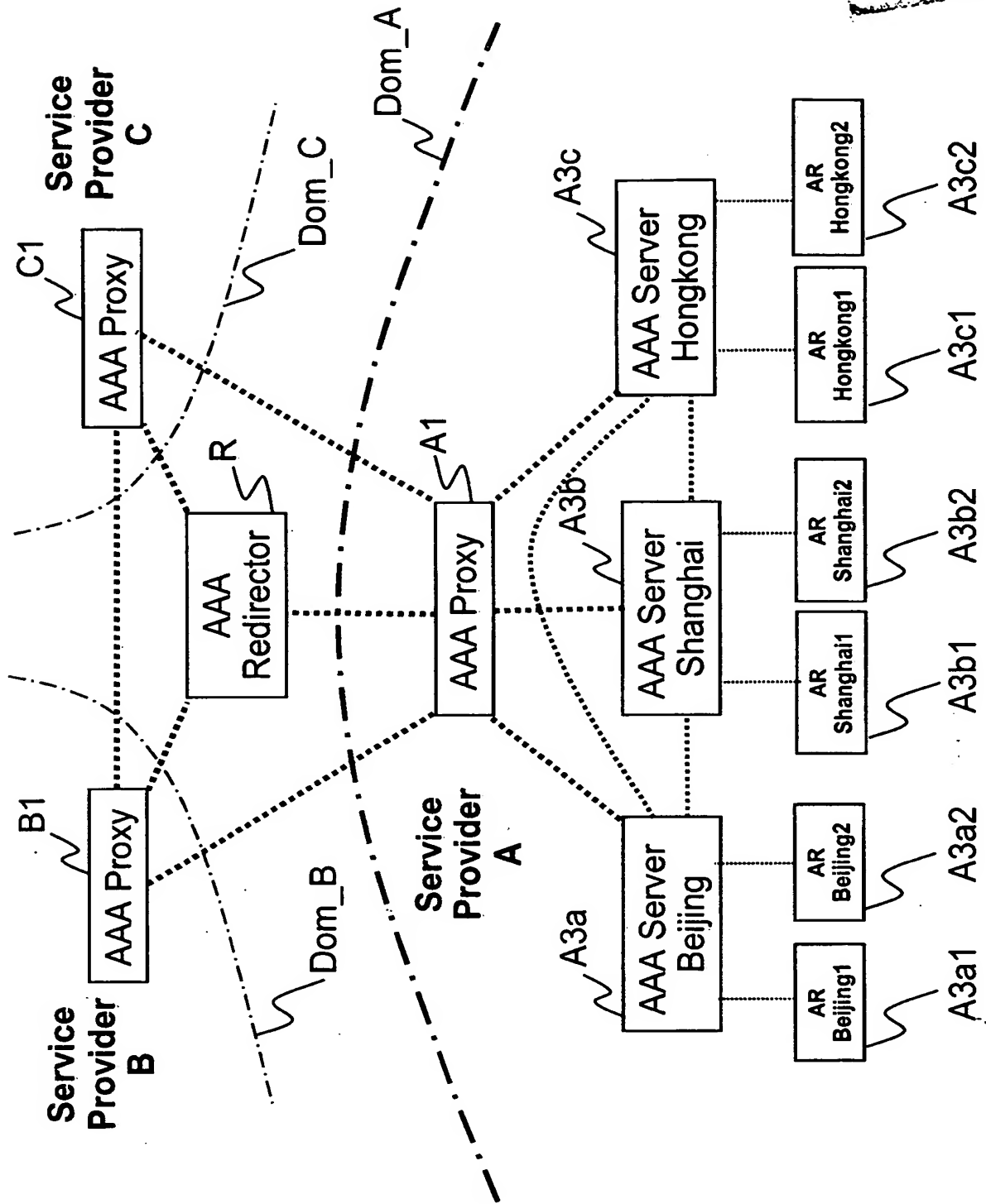


Figure 1 (PRIOR ART)

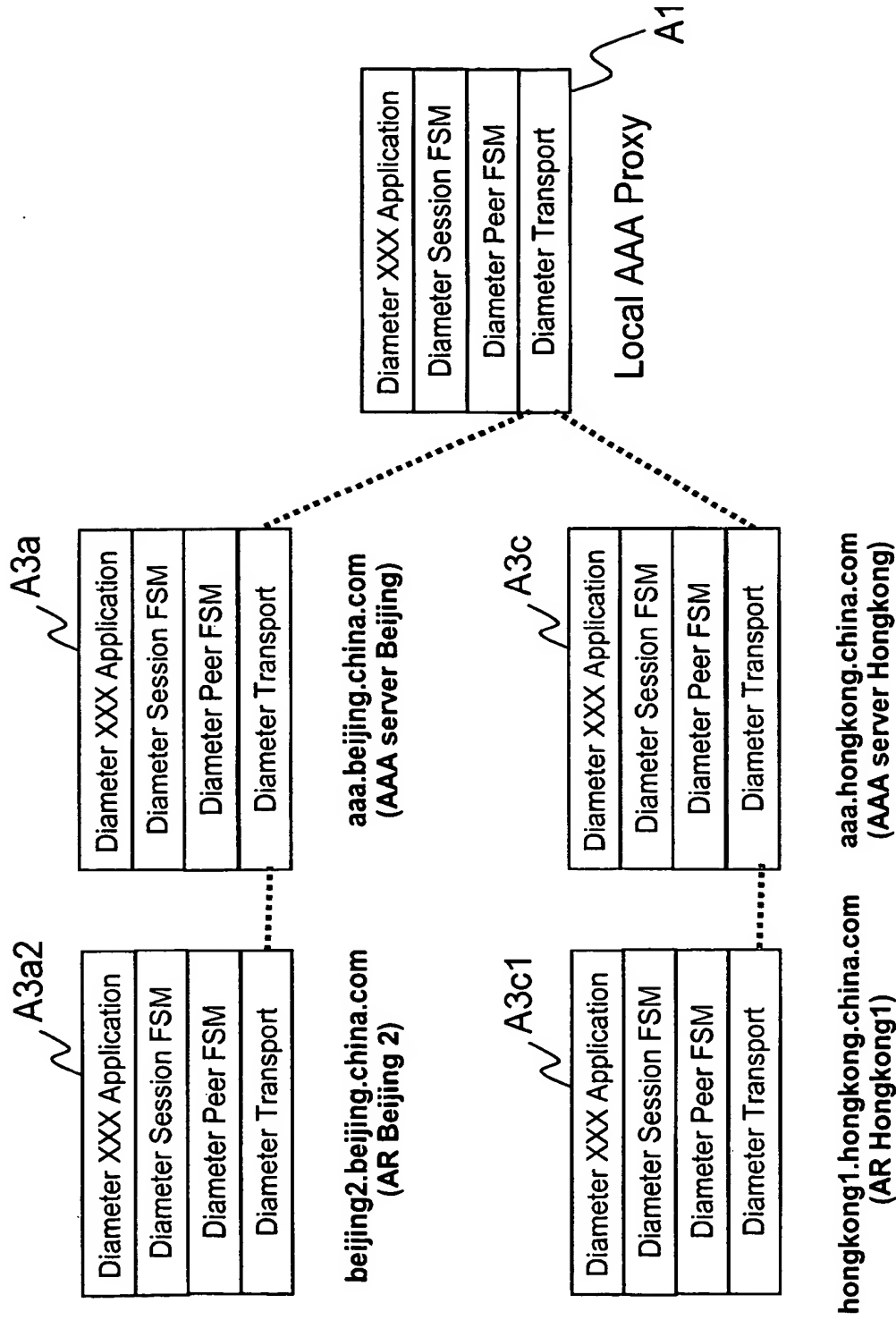


Figure 2 (PRIOR ART)

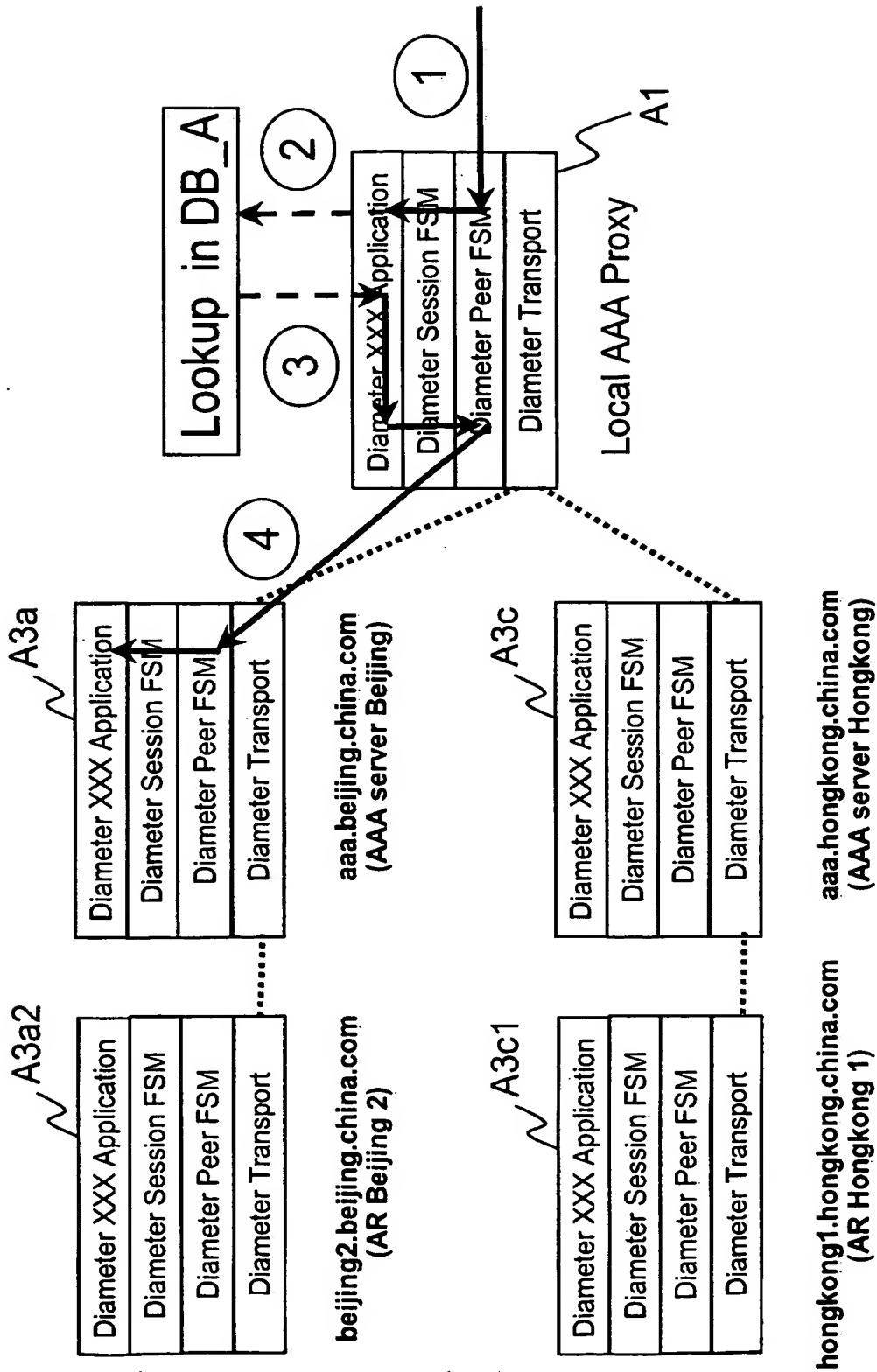


Figure 3 (PRIOR ART)

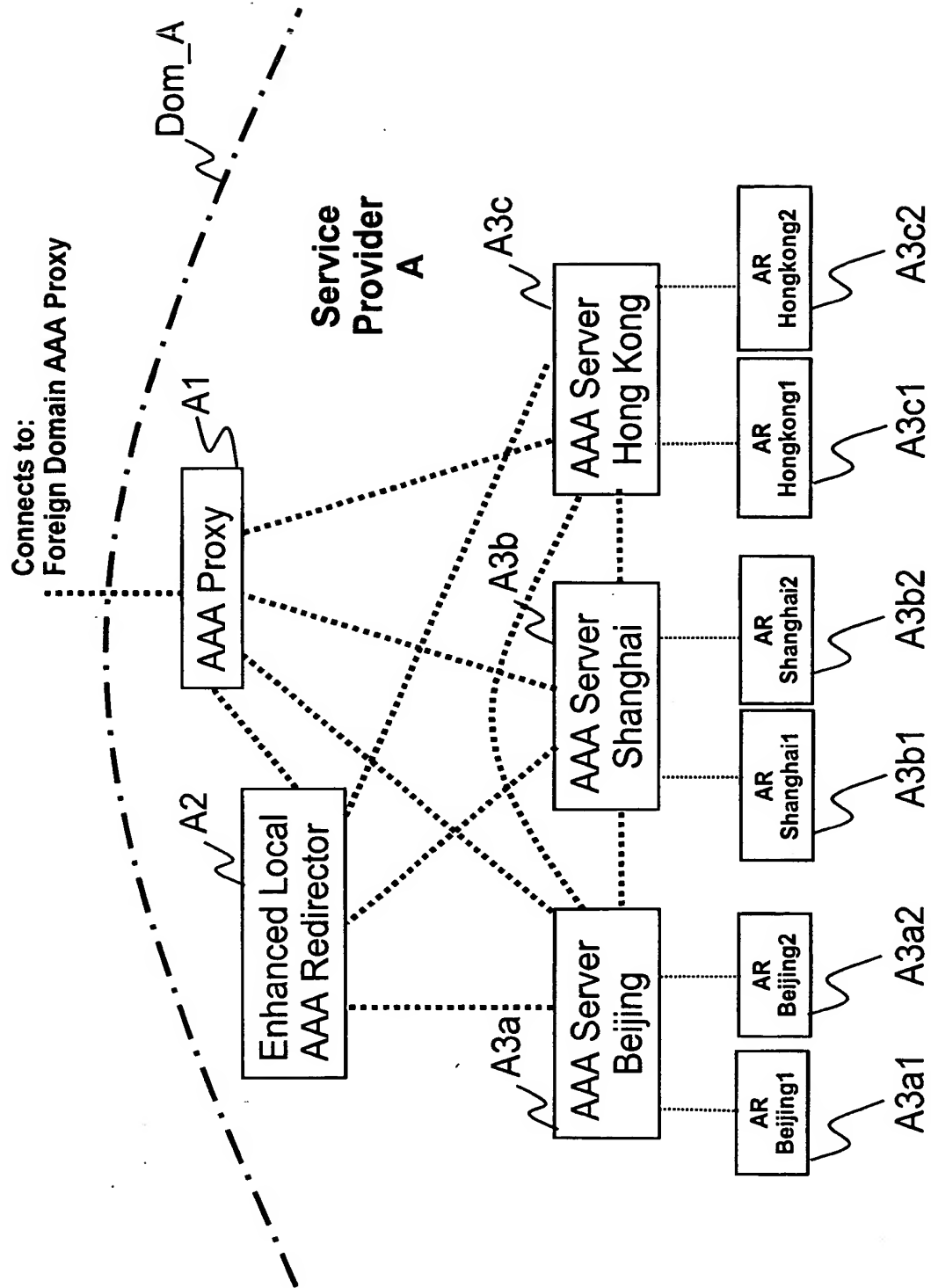


Figure 4

Source Realm	Target Realm	Action	Next Hop	Alternative Redirect-Host
*	china.com	redirect	proxy.china.com	NULL
*	finland.com	redirect	entry.finland.com	NULL
*	moon.com	redirect	portal.moon.com	entryway.moon.com

Figure 5A

Source Realm	Target Realm	Action	Next Hop	Alternative Redirect-Host
*	beijing.china.com	redirect	aaa.beijing.china.com	NULL
*	shanghai.china.com	redirect	aaa.shanghai.china.com	NULL
*	hongkong.china.com	redirect	aaa.hongkong.china.com	NULL
*	localdomain	orient	userDB.localdomain.com	NULL

Figure 5B

Source Realm	Target Realm	Action	Next Hop	Alternative Redirect-Host
*	localdomain	local	NULL	NULL

Figure 5C

Source Realm	Target Realm	Action	Next Hop	Alternative Redirect-Host
*	localdomain	relay	redirector.localdomain.com	NULL

Figure 5D

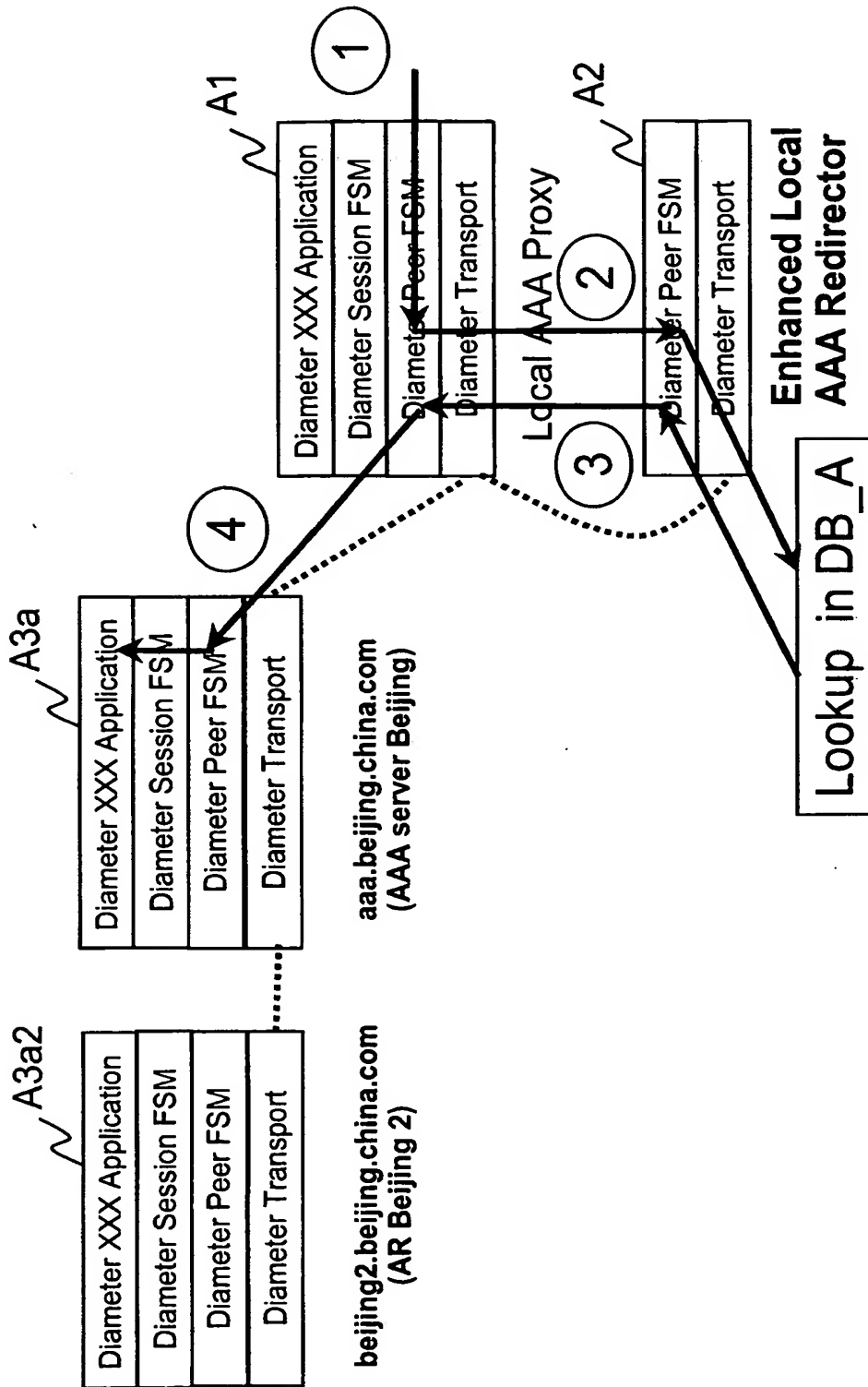


Figure 6

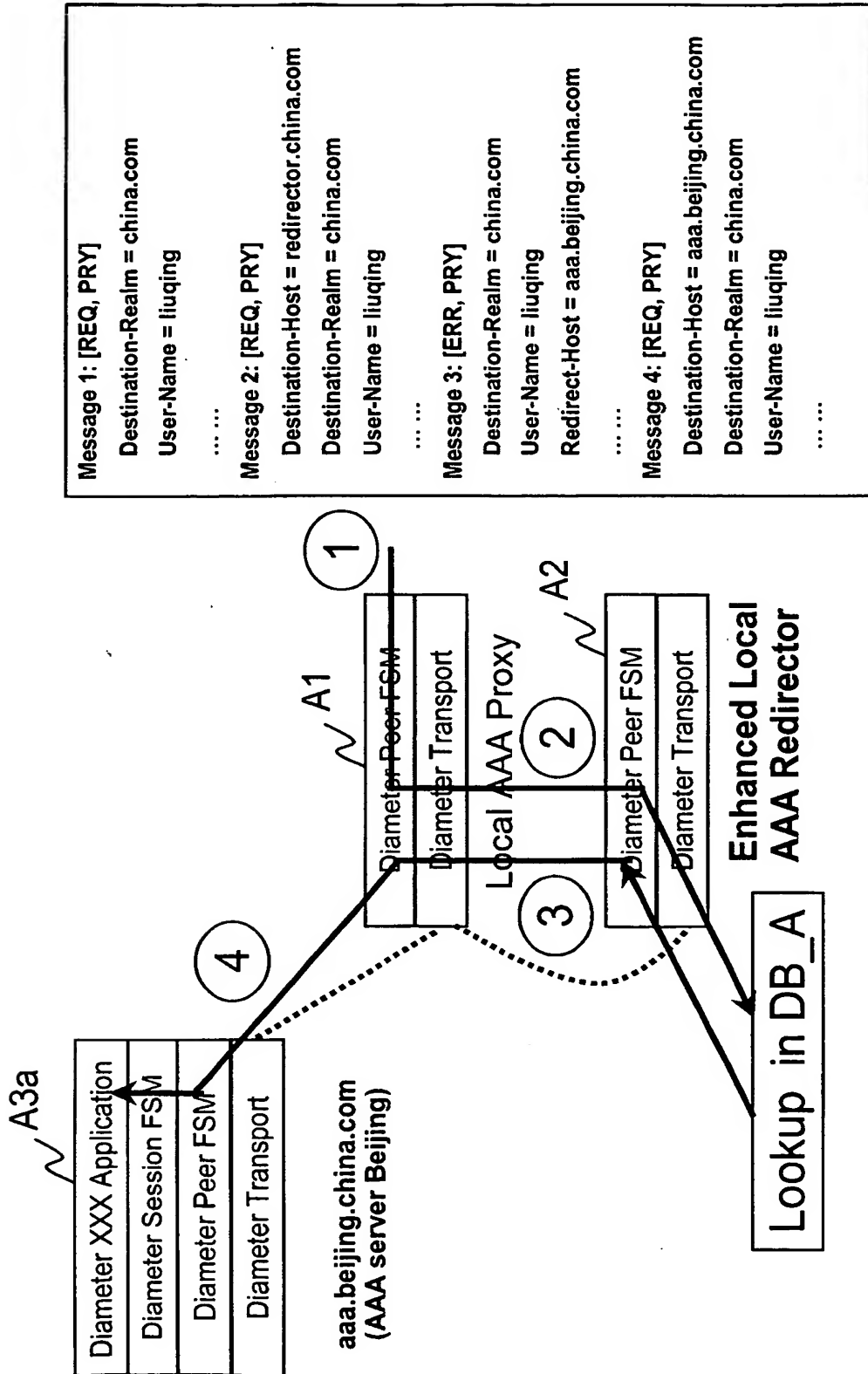


Figure 7

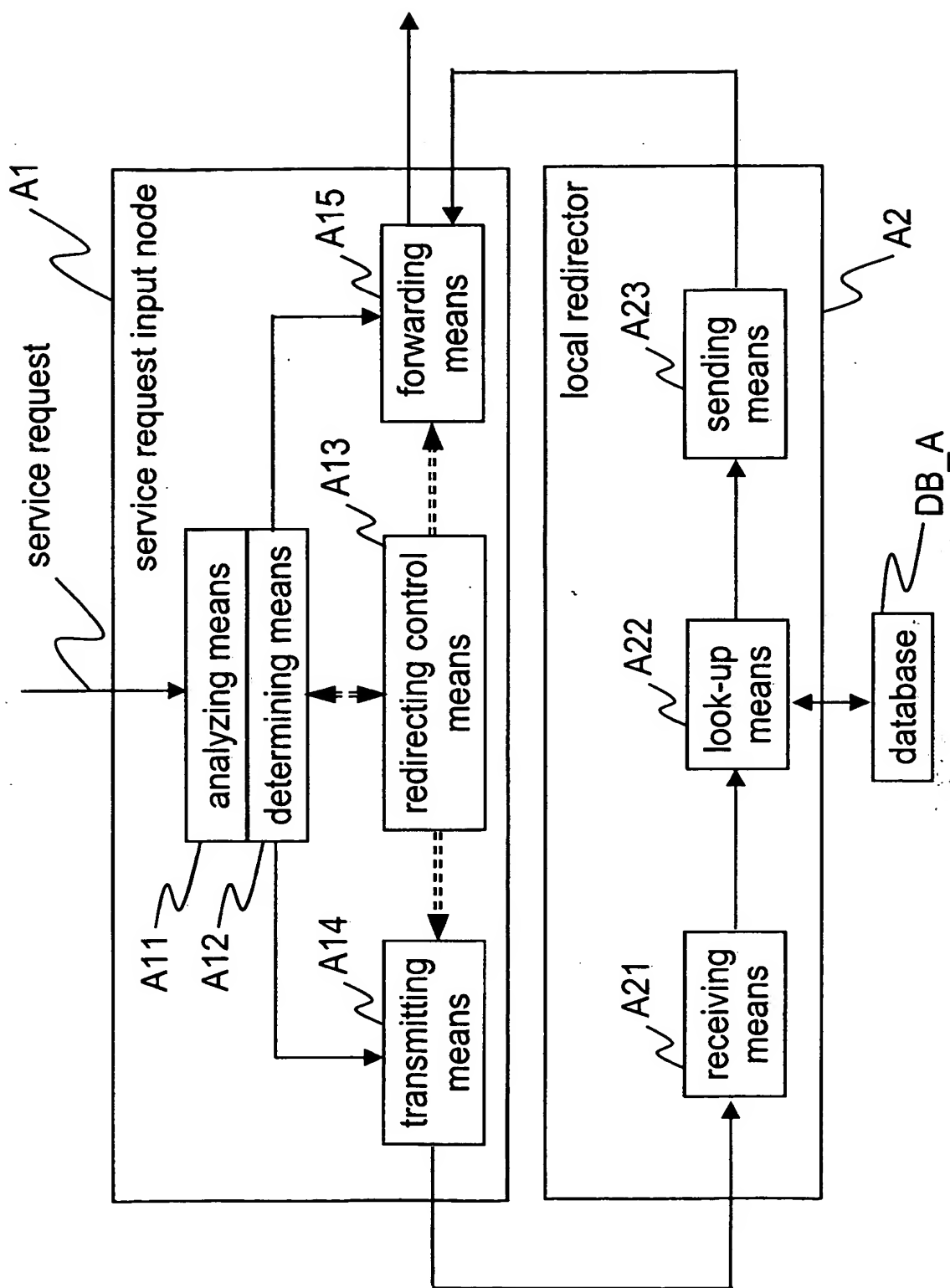


Figure 8

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